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Tulsa Tornado Tribune

Where People Who Know the Weather Get Their Weather

National Weather Service Tulsa, Oklahoma — Summer, 2007

Craig Sullivan - Editor

Floods Swamp Northeast Oklahoma

Drought Relieved by Much Above Normal Rainfall

As spring, 2007 arrived, enough winter precipitation had fallen to alleviate drought conditions over most of the area, but the drought's demise would heavily depend on what happened during the upcoming climatological "wet season". April rains were mostly concentrated in two areas...one across Osage and Pawnee counties, and another from far southeast Oklahoma through west central Arkansas. The rest of the area was off to a dry start for spring, and no doubt most were hoping for a reversal of fortune. For most of northeast Oklahoma, that wish was granted... over and over!

May is histori-

Drought Relief *Continues on page 4*

By the Numbers...

42 - Number of River Flood Warnings issued by NWS Tulsa in June

48 - Consecutive days of rain somewhere in the NWS Tulsa forecast area (6/8 - 7/25)

9 - Days since May 1 rain has not fallen in Tulsa CWA (through 7/20)

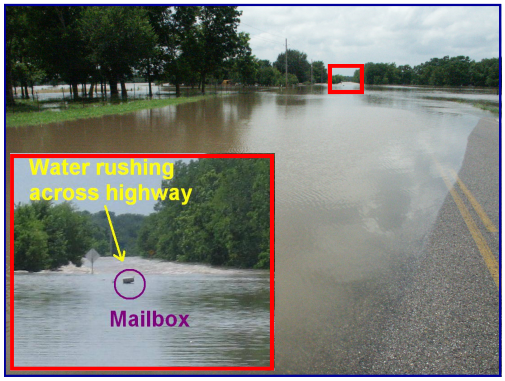
20 - Days in June with measurable rain in Tulsa (new record)

8 - Consecutive Tuesdays with rain in Tulsa (last 3 in April, all 5 in May)

2 - Months with more days of rain in Tulsa than June, 2007 (April 1957, May 1946)

Series of Heavy Rain Events Sends Area Rivers Overflowing

Wet weather quickly became the norm across eastern Oklahoma in May. The first significant rainfall event for the month occurred on the 6th and 7th as a near-tropical air mass settled over the area, causing thunderstorms to become very efficient rain producers. Between 2 and 4 inches of rain fell across much of northeast Oklahoma northwest of I-44, with even higher amounts in central Oklahoma and eastern Kansas. In the following 24-hour period, the heaviest rainfall shifted mainly into south central Oklahoma, but another 2 to 4 inches drenched parts of eastern Oklahoma west of a Muskogee to Wilburton line.



Flood waters over Highway 28 near Childers, OK Taken on July 2. Zoomed inset shows water reaching the top of a mailbox post next to the highway.

This led to the first bout with mainstem river flooding across northeast Oklahoma. In Osage county, Bird Creek overflowed across a county road west of Highway 11 south of Avant. In Tulsa County, Bird Creek overflowed and closed Highway 20 east of Skiatook.

Flooding on the Caney River in Washington County, OK closed a county road between Bartlesville and Oglesby, while downstream in Tulsa County, 176th Street North was closed north of Collinsville. In Nowata County, Highway 10 across the Verdigris River east of

River Flooding *Continues on page 2)*

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River Flooding

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Lenapah was closed. In Ottawa County, Riverview Park in Miami was flooded and Highway 125 near the fairgrounds was closed due to flooding from the Neosho River.

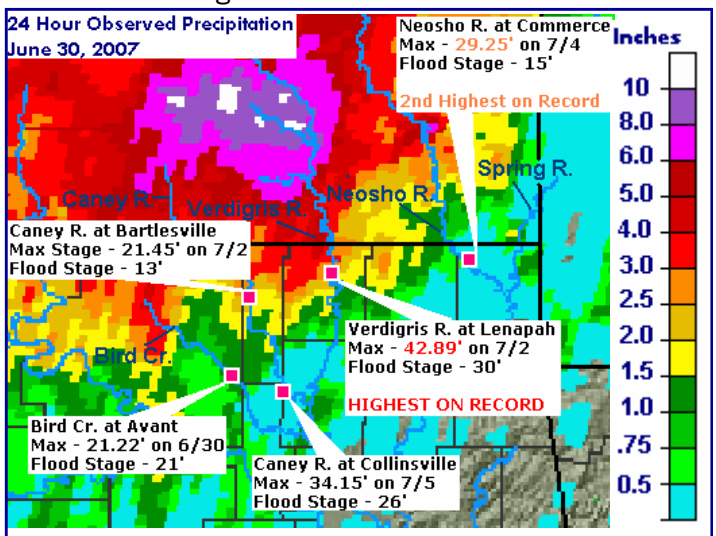
Rain fell over a large part of eastern Oklahoma on May 24-25, with amounts generally around an inch or less. On May 26-27, more heavy rain fell in south central Oklahoma, causing sharp rises along the Red River and Muddy Boggy Creek in Choctaw County. However, the rivers remained within their banks, and the month closed with rivers mostly intact.

June Monsoon

The first shot occurred on the 1st and 2nd, as intense thunderstorms produced large volumes of rainfall in central Oklahoma and parts of northeast Oklahoma. This led to a second round of flooding along the Neosho River near Commerce. From June 11-15, there was an extended period of severe storms and heavy rainfall throughout northeast Oklahoma and in the headwaters of several river basins that flowed into northeast Oklahoma.

On June 11-12 alone, Wann, OK (Nowata Co.) totaled 8.93 inches of rain in 24 hours. Rainfall amounts of 7 to 8 inches were also common in southwest Missouri and southeast Kansas. In Washington County, OK, damaging flooding occurred in Dewey as Coon Creek overflowed into the Meadowcreek subdivision and into a mobile home park. Portions of Highway 75 and Highway 123 were closed because of high water. The flooding of Coon Creek was further aggravated as it could not empty into the Caney River, which was undergoing moderate flooding at Bartlesville.

The Spring River near Quapaw crested at 32.18 feet on June 13, the 8th highest crest in history. Several county roads were closed in Ottawa County and a recreational campground was flooded. Flooding occurred along the Neosho River near Commerce and downstream in Miami, where Riverview Park was flooded and Highway 125 was closed...again. In Nowata County, Highway 10 east of Lenapah was closed...again.



10 to 15 inches of rain fell over much of southeast Kansas on June 29-30, 2007, causing significant river flooding downstream in northeast Oklahoma in early July.

From June 18-23, the headwaters of the Deep Fork River were drenched by 3 to 5 inches of rain. The Deep Fork near Beggs rose above flood stage (18 feet) on the 20th as a result, and several homes northwest of Okmulgee were isolated by the high water. This rise on the Deep Fork was enhanced by another round of heavy rains in the basin on the 26th and 27th. The river finally crested at 26.21 feet on July 1. This same round of heavy rain extended into Polecat Creek basin and caused moderate flooding downstream from Sapulpa.

The Main Event

As saturated as northeast Oklahoma had become, it only got worse as the month came to a close. Copious subtropical moisture surged north from the Gulf of Mexico while a cold front dropped into the southern plains, setting the stage for an epic rain event (see **Meteorology**).

Within the Tulsa forecast area, 6.51 inches of rain fell in Ralston (Osage Co.) on the June 28-29. Several bridges were washed out and roads were closed across Osage and Pawnee counties, including Highway 60 west of Bartlesville and Highway 18 north of Fairfax. Moderate flooding occurred along Black Bear Creek in Pawnee and along Bird Creek near Avant, Sperry, and Owasso. The major intersection of Highways 20 and 11 was closed near Skiatook.

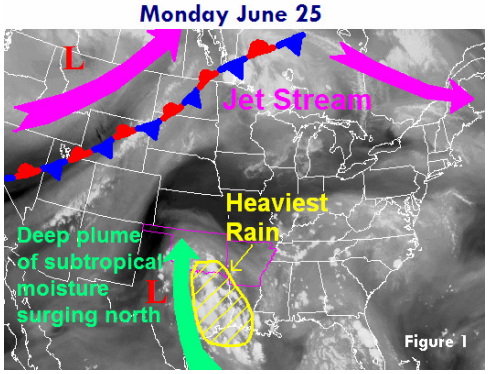
However, this was not the area which received the heaviest rainfall from this system. Torrential rains covered a broad area of southeast Kansas along the stalled front. Fredonia, KS reported 15.20 inches from June 28-30. Much of this area is drained by rivers that flow into northeast Oklahoma, and not surprisingly, extensive and even historical floods occurred as July arrived.

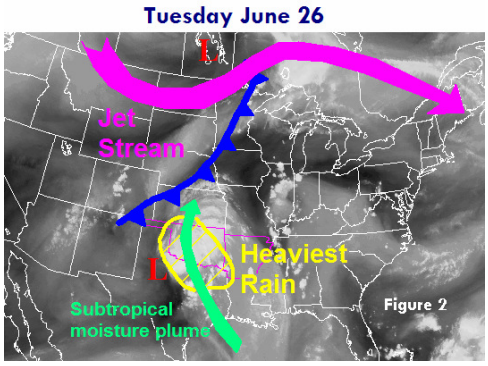
Significant flooding occurred in the

River Flooding *Concludes on page 3*

Meteorology Behind the Floods

You're all familiar with the typical transition from spring to summer in this area, which goes something like this: An active jet stream over the plains through about the first week of June, with the usual threat of severe storms, migrates north and by the late part of June, the big ridge is over us, and the heat is on. In many ways, the pattern in June, 2007 actually followed suit, but a funny thing happened on the way to summer.



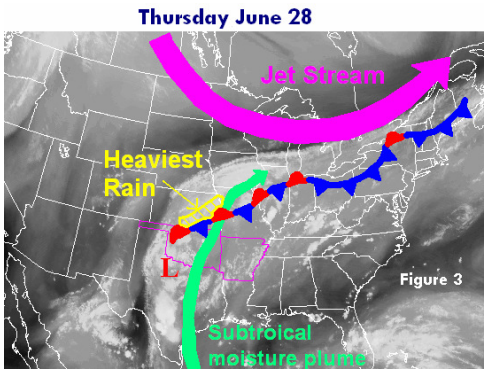


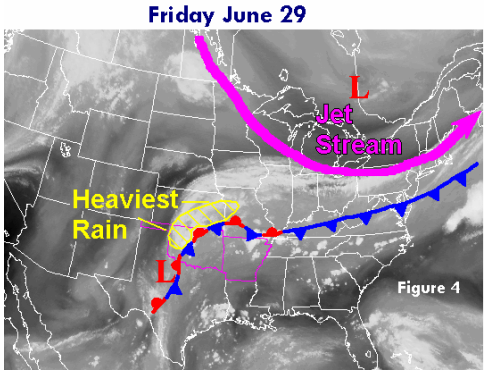
The month started with a strong upper low in the plains, which brought thunderstorms to parts of the area... nothing too unusual yet. By the end of June's opening week, a high pressure ridge began to build over the southern U.S...again nothing strange here...and by mid-month, the jet stream had shifted into the far northern states, and summer arrived on schedule, right?

Not exactly! Although a long-wave upper ridge held firm over the southern and central states through most of the remainder of June, a relative "weakness" in the upper ridge persisted over Texas and Oklahoma, even taking on the form of a weak cut-off low at times. The effects were twofold...one the normal summertime cap to convection was largely absent because of the weakness, and two, the associated low level pattern caused a persistent flow of moisture form the Gulf of Mexico into Oklahoma and Texas. This resulted in rain falling somewhere in the area every day from June 8 until the end of the month. In addition, weak steering winds led to slow moving storms, which produced occasionally spectacular local rainfall totals.

By the last week of June it was becoming clear that the pattern was not in any hurry to change. Interestingly enough, the main flood event was actually brought about by a system several hundred miles north. As this system pushed across the northern tier of states early in the week, the low level winds over our area responded and brought a deep surge of subtropical moisture into eastern Oklahoma (figures 1, 2), which led to heavy rain in some areas. By mid week, a cold front associated with the system pushed through the central plains, eventually stalling near the Oklahoma-Kansas border (Fig 3, 4). The front provided a focus for the widespread heavy rains that drenched southeast Kansas on June 29-30, which ultimately sent many rivers in northeast Oklahoma out of their banks.

It all goes to show how subtle (not to mention very difficult to predict in the long term) features often can have a tremendous impact on the weather... sometimes for weeks on end!





River Flooding

(Continued from page 2)

Caney, Verdigris, and Neosho basins during the first week of July. The Verdigris River near Lenapah reached an all-time record high crest of 42.89 feet. In addition, the Neosho River near Commerce reached its second-highest crest on record at 29.25 feet.

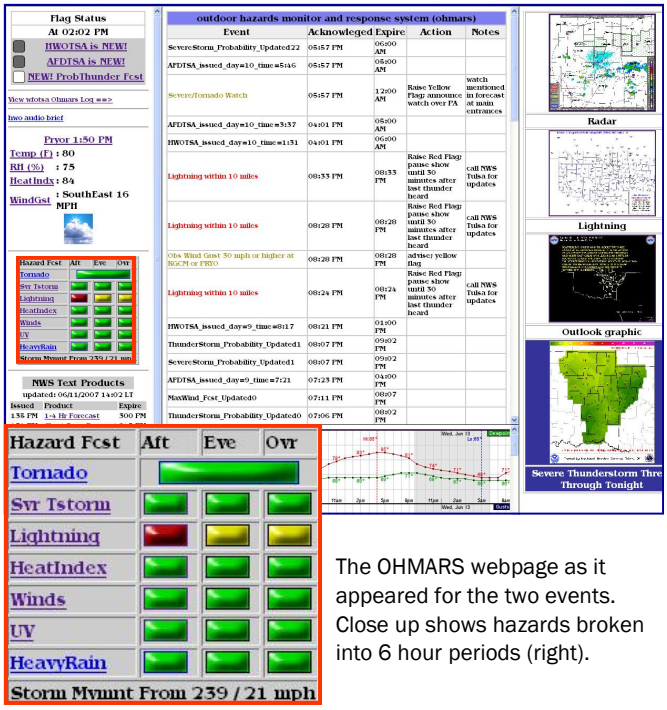
Flood waters receded by mid July, leaving residents of Bartlesville and Miami especially hard hit. Many people were only just beginning to return home as of mid-July to face a monumental clean-up. So far in July, the heaviest rains have fallen across southeast Oklahoma, while the areas hardest hit by June floods have seen much closer to normal rainfall since July 1.

Support for Large Events

A pair of large scale outdoor events was held in Mayes County this summer; Country Fever in June and Rocklahoma in July. At the request of local emergency management, the NWS Tulsa developed a support system geared toward these large outdoor venues, where minimal shelter from the weather is available. The support system, called the Outdoor Hazards Monitor and Response System (OHMARS), was set up based on the decision support page, with hazards broken down into 6 hour periods.

A website was set up for OHMARS and was monitored by Emergency Management. The EM received updates directly from an Incident Meteorologist at WFO Tulsa, who provided additional event-specific support as needed. This included output from dispersion models if necessary, continuous updates to graphical forecast products, spot forecasts for

Support *Continues on page 5*



The OHMARS webpage as it appeared for the two events. Close up shows hazards broken into 6 hour periods (right).

Drought Relief

(Continued from page 1)

cally the wettest month of the year across the region, and began with heavy rain and an early round of river floods across northeast Oklahoma (see **Flood Events**). After a lull during the middle part of May, heavy rain returned as the Memorial Day weekend approached and continued through the end of the month. As it turned out, the early May floods were only a glimpse of what would come later.

History tells us June is also one of the wettest months of the year. It also tells us that June marks the transition from the active spring storm season to the "hot and dusty" doldrums of summer. While June rainfall tends to be less frequent, especially later in the month, amounts can be spectacular...thus the high rainfall average. June, 2007 was certainly wet (see **How Much Rain**), but what truly set this month apart was that rain fell somewhere in the Tulsa forecast area virtually every day !

The impacts of all this water have been significant as one might expect. Several thousand residents in the Bartlesville and Miami areas were evacuated as water rose to several feet in some homes and businesses. A serious environmental scare occurred as an oil spill at a refinery in Coffeyville, KS threatened to send 1000 barrels of crude oil down the Verdigris River and into Oologah Reservoir. Fortunately, no public water supply intakes showed any adverse affects.

Flood waters gradually spilled into the Arkansas River, with some minor flooding downstream at Muskogee, and moderate flooding at Van Buren early in July.

The upside to all of this was the impact on area reservoirs that had been below normal for a lengthy period of time. At the beginning of May, Skiatook and Grand in northeast Oklahoma were at 78 percent and 87 percent of their normal pools respectively. By the end of the month, Skiatook was above normal for the first time in over two years, and Grand was at 95 percent of its normal pool.

However, there can always be too much of a good thing, and by late June, lakes that just over a year ago were at extremely low levels, were threatening to top their flood control pools . Hulah Reservoir in Osage County reached the top of its flood control pool, while several others reached about 50 percent of theirs.

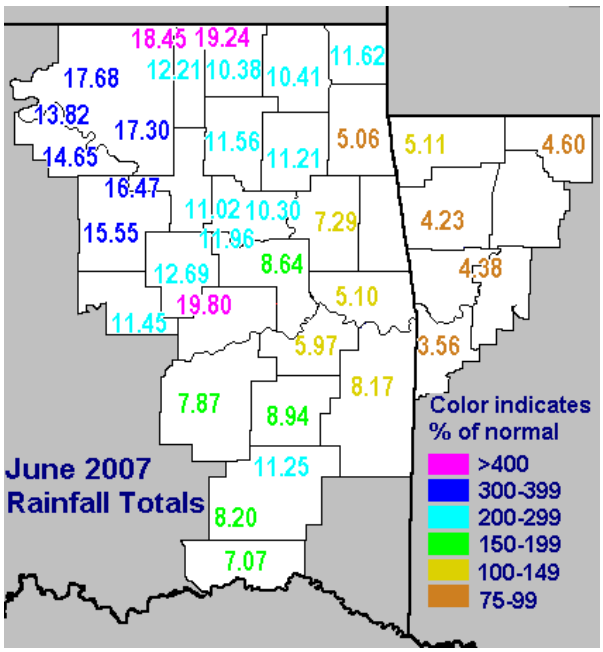
The real good news out of all this...at the end of June, the U.S. Drought Monitor (USDM) did not include any parts of the Tulsa forecast area in the abnormally dry category.

How Wet Was It?

Obviously, spring and early summer have been wet...but just how wet has it been? Surprisingly, not all of the area has shared in the wealth of rainfall.

As for the spring season (March-May), most of northeast Oklahoma saw above normal rainfall, but the remainder of the area including southeast Oklahoma and western Arkansas were drier than normal. Statistically it was only the 24th wettest spring for all of Oklahoma. By contrast, Arkansas seemed to mark a transition between the wetter areas in Oklahoma to a record spring drought in the southeast U.S. Statewide, Arkansas recorded its 3rd *driest* spring ever!

June is historically a transitional month sandwiched between the wettest month of the year (May) and one of the drier months (July) for the Tulsa forecast area. However, for northeast Oklahoma, June 2007 will be remembered as one of the wettest Junes in history. According to the Oklahoma Climatological Survey (OCS), the Northeast Oklahoma climatological district had its second wettest June since 1895, surpassed only by 1948.



Also, according to OCS statistics, it was the third wettest May-June in northeast Oklahoma with precipitation 181 percent of normal. The east central Oklahoma district had 128 percent of its normal precipitation for the combined May-June period while the southeast Oklahoma district received 122 percent of its normal rainfall.

For all the heavy rainfall which drenched eastern Oklahoma in June, northwest Arkansas was slightly below their normal rainfall for the month. Both Fayetteville and Fort Smith trailed their normal monthly rainfall for June. While some stations in northeast Oklahoma were already well ahead of their entire 2006 total, and not far from their yearly average, year-to-date precipitation was 4.30 inches below normal at Fayetteville and 0.66 inches below normal at Fort Smith as of June 30.

Support

(Continued from page 4)

the venue and surrounding areas, radar updates and notification of hazards exceeding certain action thresholds.

Leading up to the events, a number of planning meetings occurred to develop a preparedness plan to mitigate the loss of life and property that could possibly be threatened by weather and other hazards during the event. Attendance at these meetings included the Mayes County Emergency Management Director, the Warning Coordination Meteorologist of NWS Tulsa, the County Sheriff, the Director of Mayes County Emergency Medical Services, the Director of Mayes County 911, the Fire Chief and Asst. Chief of Pryor Fire Department, and a public health specialist of Mayes County Health Department. Action thresholds were divided into "red", "yellow" and "white" alert levels. A red alert level would be an event necessitating sheltering of those at the venue; i.e. lightning detected within a 10 mile radius, Severe Thunderstorm and Tornado warnings valid for the site, and observed winds more than 40 mph at Claremore or Pryor mesonet.

Excessive Heat

The following changes have been made to NWS Tulsa excessive heat advisory and warning criteria…

Excessive Heat Warning (Watch)

Two or more days with heat index ≥ 105° F, and overnight lows ≥ 75 ° F.

Heat Advisory

Heat index ≥ 105 ° F. **Note**: There is no longer an overnight low or duration criteria for a Heat Advisory.

Summer Tornadoes

In spite of another below average tornado season , a pair of tornadoes touched down in our forecast area early this summer. A brief tornado occurred June 20, 3 miles southwest of Figure Five in Crawford County, AR. The tornado formed along the leading edge of a squall line that moved rapidly north through the county. Another brief tornado touchdown occurred on July 9 near Warner in Muskogee County, OK. Both tornadoes produced EF-1 damage along relatively short paths.

How uncommon, are summer tornadoes in this area? Before answering that question, let's qualify what we mean by summer. The climatological definition includes the months of June through August. However, June has produced enough significant tornado outbreaks to exclude it as a summer month...true, you could include the period after, say, June 15, as part of summer, but it's MUCH easier to restrict it to July and August!

Statistics (since 1950)

Oklahoma

	total	F2 +	injuries
July	26	3	6
August	17	1	2

Arkansas

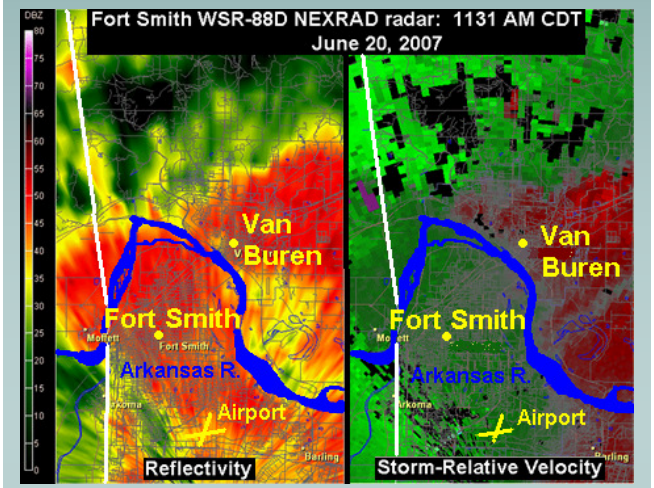
	total	F2 +	injuries
July	4	0	0
August	0	0	0

Conclusion; there are not many tornadoes in summer (big surprise)! The Warner, OK tornado was the first to occur in July or August in the Tulsa forecast area since August 26, 1999, when a small tornado damaged a barn and a mobile home in Rogers County. For the record, it was 109 degrees in Tulsa that afternoon, so there is no truth to the rumor that it is too hot in the summer for tornadoes. The lack of tornadoes has more to do with the lack of upper level support as the jet stream is usually way north of here in the summer. While the atmosphere can be *very* unstable on a hot, humid summer day (no shortage of those here), the necessary wind shear to create supercell storms is rarely available.

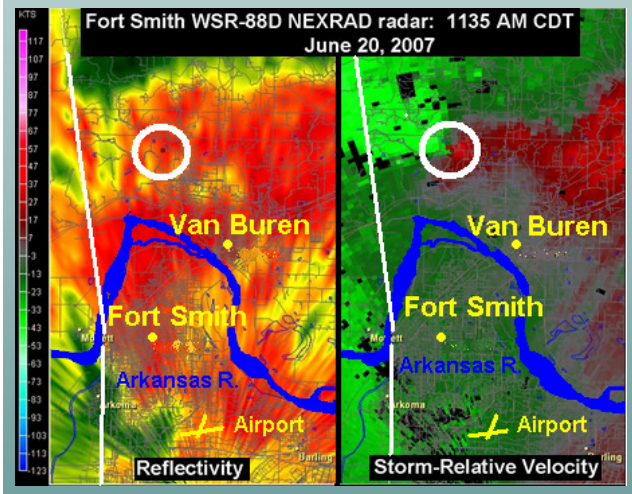
Since 1950, exactly four significant tornadoes (F2 damage or more) have occurred in our forecast area during July or August. On July 2, 1992, an F3 tornado produced a 4 mile swath of damage in northern Tulsa and Rogers counties, and injured one person. An F2 tornado injured two people west of Okay, OK (Wagoner Co.) on August 27, 1982. The closest thing to a summer outbreak occurred on July 1, 1957, producing two F2 tornadoes; one in Creek County, OK and another in the city of Tulsa. Summer tornadoes are most often like the ones we saw this year; brief, weak and usually associated with the gust front, or perhaps a "landspout" or non-supercell tornado.

Crawford County Tornado... A Closer look

A brief tornado occurred on June 20 at 11:15 AM, 3 miles southwest of the town of Figure Five, AR. The tornado formed along the leading edge of an accelerating squall line that moved rapidly north through Crawford County and produced sporadic wind damage. The tornado was rated an EF-1 with a path width of 250 yards and path length of about one half mile. The images below show radar data from the Fort Smith 88D around the time of the tornado.



The radar image above shows data from 1131 AM...four minutes before the tornado. No radar indications were present of anything more than strengthening winds that prompted a severe thunderstorm warning.



Rotation suddenly develops within the white circle. The red and green pattern marks the rotation...green is air moving toward the radar, and red is air moving away from the radar. This radar signature disappeared on the next volume scan four minutes later.